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Frank S. Rosenberg
18 Echo Hill Lane
Moraga, CA 94556

EXAMINER	
LEUNG, JENNIFER A	
ART UNIT	**PAPER NUMBER**
1764	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/076,915	Applicant(s) TONKOVICH ET AL.	
	Examiner Jennifer A. Leung	Art Unit 1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31 and 64-85* is/are pending in the application.

4a) Of the above claim(s) *64-74* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31 and 75-85* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-31 and 64-85* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 January 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment submitted on January 13, 2006 has been received and carefully considered. The newly submitted formal drawings are acceptable. Claims 32-63 are cancelled. Claims 64-85 are newly added. Claims 1-31 and 64-85 are active.

Election/Restrictions

2. Newly submitted claims 64-74 are directed to an invention that is independent or distinct from the invention originally elected for the following reasons:

> The subject matter of the newly submitted claims is directed to a microchannel device comprising at least one microchannel, and a process of fluid processing using said microchannel device. This "microchannel" subject matter was withdrawn, without traverse, in the response to restriction requirement submitted on May 3, 2005.

Since applicant has received an action on the merits for the originally elected invention, this invention has been constructively elected for prosecution on the merits. Accordingly, claims 64-74 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-31 and 75-85 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 1, it is unclear as to the relationship between "a fluid" in line 2, "a fluid" in line 12, and "a fluid" in line 14. Also, it is unclear as to the relationship between "a device" in line 1 and "a device" in line 13. Also, it is unclear as to the relationship between "a unit operation" in lines 11-12, "a unit operation" in lines 13-14, and the "unit operations" in lines 1-2.

Regarding claim 3, it is unclear as to the relationship between "an aperture" (line 2) and "an aperture" set forth in claim 2, line 2. Also, it is unclear as to the relationship between "a device" in line 7 and "a device" in claim 1, line 13. Also, it is unclear as to the relationship between "a flow path" in line 8 and "a... flow path" set forth in claim 1, lines 3-4.

Regarding claim 6, the "any other flow paths" lack proper positive antecedent basis (please note than only one flow path in the device was recited in claim 1), and it is unclear as to its structural relationship to other elements of the device.

Regarding claim 9, it is unclear as to the relationship between "a fluid" in line 2 and "a fluid" set forth in claim 1, lines 2, 12 and 14. Also, it is unclear as to the relationship between "a unit operation" in line 1 and "a unit operation" or "unit operations" set forth in claim 1, lines 1, 11-12 and 13-14.

Regarding claim 10, it is unclear as to the relationship between "a plurality of shims" in line 4 and "a plurality of shims" in lines 1-2. Also, it is unclear as to the relationship between "a device" in line 14 and "a device" set forth in line 1. Also, it is unclear as to the relationship between "a fluid" in line 1, "a fluid" in line 15, and "a fluid" in line 16 (twice). Also, it is unclear as to the relationship between the "at least one unit operation" in line 18 and "a unit operation" set forth in lines 2-3.

Regarding claim 12, "the borders of apertures" (lines 2-3) lacks proper positive

antecedent basis.

Regarding claim 13, it is unclear as to the relationship between "a unit operation" (lines 1-2), "a unit operation" (lines 11-12) and "at least one unit operation" (line 15). Also, it is unclear as to the relationship between "a fluid" (line 2), "a fluid" (line 12) and "a fluid" (line 13).

Regarding claim 15, the "any other flow paths" lack proper positive antecedent basis (please note that only a single flow path in the device was recited in claim 13), and it is unclear as to its structural relationship to the other elements of the device.

Regarding claim 24, it is unclear as to the relationship between "a unit operation" (line 1), "a unit operation" (lines 11-12) and "at least one unit operation" (line 15). Also, it is unclear as to the relationship between "a fluid" (lines 1-2), "a fluid" (line 12) and "a fluid" (line 13).

Regarding claim 27, it is unclear as to the relationship between "a unit operation" in line 3, "a unit operation" in lines 8-9, and the "at least one unit operation" in lines 16-21. Also, it is unclear as to the relationship between "a fluid" in line 2, "a fluid" in line 9, "and "a fluid" in line 14. Also, it is unclear as to the relationship between "a device" in line 1 and "a device" in line 8.

Regarding claim 85, it is unclear as to the relationship between "a fluid" (line 5) and "a fluid" set forth in claim 13, lines 2, 12 or 13.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-4, 6-17, 21, 24-30, 79 and 85 are rejected under 35 U.S.C. 102(b) as being anticipated by Schoenman et al. (US 3,881,701).

Regarding claims 1 and 8, Schoenman et al. (FIG. 1, 2; column 2, line 65 to column 4, line 36) discloses a device **10** and a process of making the device **10** comprising:

stacking a plurality of shims (e.g., plates **16, 18, 20, 22, 24**) such that a continuous flow path is formed through the shims (e.g., a flow path for fluid, denoted by arrow **60**); and bonding the shims (i.e., by diffusion bonding, brazing, or adhesive; column 3, lines 6-9); wherein, the flow path **60** extends in a direction substantially parallel to the shim thickness (see FIG. 2); the plurality of shims **16, 18, 20, 22, 24** comprises at least three adjacent shims through which a flow path **60** is formed (see FIG. 2); and a straight, unobstructed line is present through the flow path **60** in said at least three shims (see FIG. 2).

Regarding claims 2-4, shims **20, 22, 24** are identical and comprise apertures **48, 46, 44** to form a channel (i.e., for flow path **60**) having a cylindrical or prismatic shape (see FIG. 1, 2).

Regarding claim 6, the flow path **60** in said at least three shims **16, 18, 20, 22, 24** does not mix with any other flow paths (see FIG. 2).

Regarding claim 7, Schoenman et al. placing a static mixer in the flow path (i.e., opposing passages **134**, for direct impingement of fluids entering paths **126, 128**; FIG. 3).

Regarding claim 9, Schoenman et al. conducts a unit operation (column 3, lines 24-30) by passing a fluid (i.e., supplied from channel **59** to flow path **60**) through the device **10**.

Regarding claim 10, Schoenman et al. (FIG. 1, 2; column 2, line 65 to column 4, line 36) discloses a process of making a device **10**, comprising,

stacking a plurality of shims **16, 18, 20, 22, 24** such that a flow path **60** is formed through

shims **16, 18, 20, 22, 24;** and bonding the shims (i.e., by diffusion bonding, brazing, or adhesive; column 3, lines 6-9); wherein, the flow path **60** extends in a direction substantially parallel to the shim thickness (see FIG. 2); the plurality of shims **16, 18, 20, 22, 24** comprises at least three adjacent shims through which a flow path **60** is formed (see FIG. 2); a straight, unobstructed line is present through the flow path **60** in said at least three shims (see FIG. 2); and the flow path **60** in said shims **16, 18, 20, 22, 24** does not mix with other flow paths (see FIG. 2).

Schoenman et al. further discloses the passing of fluid into the device **10** such that a fluid (i.e., as supplied from channel **59**) passes through the flow path **60** in said at least three shims **16, 18, 20, 22, 24**; and performing at least one unit operation (see column 3, lines 24-30) on the fluid as it passes through the flow path **60** in said at least three shims **16, 18, 20, 22, 24.**

Regarding claims 11, the flow path (see FIG. 1, 2) formed in said at least 3 shims **20, 22, 24** is defined by the borders of apertures **48, 46, 44,** respectively, in said shims, wherein in each of said shims **20, 22, 24** there is a border of said apertures defining a flow path **60,** the border having a circumference and said circumference in each shim is at least 20% populated by edge features (i.e., as shown in FIG. 1, 2, fully or 100% populated).

Regarding claim 12, the flow path (see FIG. 1, 2) formed in said at least 3 shims **20, 22, 24** is defined by the borders of apertures **48, 46, 44,** respectively, in said shims, wherein, in at least one of said at least 3 shims **20, 22, 24,** there is a border of said apertures defining a flow path **60,** the border having a circumference and said circumference of each shim is at least 20% populated by edge features (i.e., as shown in FIG. 1, 2, fully or 100% populated), and wherein in another of said at least 3 shims (i.e., shims **14, 16, 18**) there is a border (i.e., of apertures **54, 52,** and **50,** respectively) defining a flow path **60,** and the border is smooth.

Regarding claim 13, Schoenman et al. (FIG. 1, 2; column 2, line 65 to column 4, line 36) discloses a process of conducting a unit operation of a fluid comprising:

passing a fluid into a device **10** such that the fluid (i.e., as supplied from channel **59**) passes through the flow path **60** in at least three shims **16, 18, 20, 22, 24**; and performing at least one unit operation (see column 3, lines 24-30) on the fluid as it passes through the flow path **60** in said shims **16, 18, 20, 22, 24**.

Schoenman et al. further discloses a process of making the device **10**, comprising,

stacking a plurality of shims **16, 18, 20, 22, 24** such that a continuous flow path **60** is formed through shims **16, 18, 20, 22, 24;** and bonding the shims (i.e., by diffusion bonding, brazing, or adhesive; column 3, lines 6-9); wherein the flow path **60** is substantially parallel to the shim thickness (see FIG. 2); the plurality of shims **16, 18, 20, 22, 24** comprises at least three shims through which a flow path **60** is formed (see FIG. 2); and a straight, unobstructed line is present through the flow path **60** in said shims (see FIG. 2).

Regarding claim 14, Schoenman et al. discloses the device **10** is capable of performing a chemical reaction (e.g., chemical process mixing with reactive fluids; column 2, lines 4-19).

Regarding claim 15, the flow path **60** in said at least three shims **16, 18, 20, 22, 24** does not mix with any other flow paths (see FIG. 2).

Regarding claims 16 and 17, the fluid (i.e., as supplied from channel **59**) may comprise at least a portion of a reaction composition (i.e., in the case of chemical process mixing with reactive fluids; column 2, lines 4-19). Also, Schoenman et al. discloses a second fluid (i.e., as supplied from channel **30**) passes through a second flow path (i.e., as denoted by arrow **58**) in said at least three shims (i.e., shims **16, 18, 20, 22, 24,** including shims **12** and **14**), wherein flow

path **60** and flow path **58**, within the device **10**, do not mix (see column 4, lines 26-32).

Regarding claim 21, Schoenman et al. discloses that the second fluid comprises a heat exchange fluid (i.e., channels **30** deliver fluid from one side of device **10** across the device and along and in heat exchange relationship to the inner surface of plate **12**; column 3, lines 44-68).

Regarding claim 24, Schoenman et al. (FIG. 1, 2; column 2, line 65 to column 4, line 36), as best understood, discloses a process of conducting a unit operation on a fluid comprising:

passing a fluid into a device **10** such that the fluid (i.e., as supplied from channel **59**) passes through the flow path **60** in at least three shims **16, 18, 20, 22, 24**; and performing at least one unit operation (see column 3, lines 24-30) on the fluid as it passes through the flow path **60** in said shims **16, 18, 20, 22, 24**.

Schoenman et al. further discloses a process of making the device **10**, comprising,

stacking a plurality of shims **16, 18, 20, 22, 24** such that a continuous flow path **60** is formed through shims **16, 18, 20, 22, 24;** and bonding the shims (i.e., by diffusion bonding, brazing, or adhesive; column 3, lines 6-9); wherein the flow path **60** is substantially parallel to the shim thickness (see FIG. 2); the shims **16, 18, 20, 22, 24** comprise at least three shims through which a flow path **60** is formed (see FIG. 2); and the flow path **60** in said shims has a minimum dimension (height or width) of at least 10 μm (i.e., dimensions on the same order of magnitude of the plate thickness; column 3, lines 13-23).

Regarding claim 25, the unit operation comprises a chemical reaction or heating and cooling (column 3, lines 24-30; column 2, lines 4-20).

Regarding claim 26, the flow path **60** has a passage width on the same order of magnitude of the plate thickness, and is therefore less than the recited maximum dimension of

5000 μm (column 3, lines 13-23). Also, assuming a minimum typical plate thickness of 0.002 inch, the flow path **60** has a maximum height less than 5000 μm (i.e., for the number of plate layers shown in FIG. 2).

Regarding claim 27, Schoenman et al. (FIG. 1, 2; column 2, line 65 to column 4, line 36) discloses a process of making a device from a plurality of shims, comprising,

stacking a plurality of shims **16, 18, 20, 22, 24** such that a continuous flow path **60** is formed through shims **16, 18, 20, 22, 24;** and bonding the shims (i.e., by diffusion bonding, brazing, or adhesive; column 3, lines 6-9); wherein the flow path **60** is substantially parallel to the shim thickness (see FIG. 2).

Schoenman et al. further discloses the use of the device for conducting a unit operation of heat, cooling, and/or reacting (column 3, lines 24-30; column 2, lines 4-20) by passing a fluid (i.e., as supplied from channel **59**) through said device **10** such that the fluid passes through the flow path **60** in said plurality of shims **16, 18, 20, 22, 24**; and performing the unit operation on the fluid as it passes through the flow path **60** in said shims **16, 18, 20, 22, 24.**

Regarding claim 28, the plurality of shims comprises at least three shims (i.e., plates **16, 18, 20, 22, 24**) through which a flow path **60** is formed, and a straight line can be drawn through the flow path **60** in said at least three shims **16, 18, 20, 22, 24**. (see FIG. 2).

Regarding claim 29, the device **10** is capable of at least two unit operations (i.e., reaction and heat exchange by heating or cooling; column 3, lines 24-30; column 2, lines 4-20).

Regarding claim 30, Schoenman et al. discloses a second flow path (i.e., as denoted by arrow **58**) adjacent to said flow path **60**, wherein a heat transfer fluid flows through the second flow path **58** (i.e., channels **30** deliver fluid from one side of device **10** across the device and

along and in heat exchange relationship to the inner surface of plate **12**; column 3, lines 44-68).

Regarding claim 79, the mixer comprises a structure that forms a helical pattern, double helical pattern, spiral pattern, or alternating spiral pattern (e.g., see FIG. 4, wherein the shims define a swirl chamber **232** for mixing two fluids according to a vortex action).

Regarding claim 85, the process comprises passing a fluid and conducting a unit operation of said fluid that flows through a flow path **60** formed in at least five shims, wherein a straight, unobstructed line is present through the flow path in said at least five shims (e.g., shims **16, 18, 20, 22** and **24**; see FIG. 2).

Instant claims 1-4, 6-17, 21, 24-30, 79 and 85 read on the processes of Schoenman.

5. Claims 1, 2, 4-6, 8-17, 21, 24-30 and 75-78 are rejected under 35 U.S.C. 102(a) as being anticipated by Bennett et al. (US 6,192,596).

Regarding claims 1 and 8, Bennett et al. (FIG. 2a, 2b, 2c; column 5, line 51 to column 6, line 39) discloses a device (i.e., a reactor **200**) and a process of making device **200** comprising:

stacking a plurality of shims (i.e., shims **1-8**; see FIG. 2b) such that a continuous flow path (e.g., for a Reactant Gas; see FIG. 2a) is formed through the shims; and bonding the shims **1-8** (e.g., by diffusion bonding; column 6, lines 28-35); wherein, the flow path (Reactant Gas) extends substantially parallel to the shim thickness (see FIG. 2a, 2b); the plurality of shims **1-8** comprises at least three adjacent shims through which a flow path is formed (column 6, lines 11-21; FIG. 2b); and a straight, unobstructed line is present through the flow path in said shims **1-8** (column 6, lines 11-21; FIG. 2b).

Regarding claims 2 and 75, each of the at least three adjacent shims **1-8** comprises apertures of irregular shapes, rectangles, and squares (see FIG. 2b).

Regarding claim 4, at least 3 shims are identical (see column 6, lines 11-21).

Regarding claim 5, Bennett et al. discloses the step of placing a partial oxidation catalyst (see FIG. 2a) in said flow path.

Regarding claim 6, the flow path (i.e., for a Reactant gas) in said at least three shims does not mix with any other flow paths (see FIG. 2a).

Regarding claim 9, Bennett et al. (column 5, lines 51-60) discloses a process of conducting a unit operation (i.e., a chemical reaction of partial oxidation) comprising the step of passing a fluid (i.e., a hydrocarbon feedstock, labeled "Reactant gas in") through the device **200**.

Regarding claim 10, Bennett et al. (FIG. 2a, 2b, 2c; column 5, line 51 to column 6, line 39) discloses a process of making a device (reactor **200**) from a plurality of shims, comprising:

stacking a plurality of shims (i.e., shims **1-8**; see FIG. 2b) such that a continuous flow path (e.g., for a Reactant Gas; see FIG. 2a) is formed through the shims; and bonding the shims **1-8** (e.g., by diffusion bonding; column 6, lines 28-35); wherein, the flow path (for Reactant Gas) extends in a direction substantially parallel to the shim thickness (see FIG. 2a, 2b); the plurality of shims comprises at least three adjacent shims through which a flow path is formed (see column 6, lines 11-21; FIG. 2b); a straight, unobstructed line is present through the flow path in said at least three shims **1-8** (see column 6, lines 11-21; FIG. 2b); and the flow path (for a Reactant gas) in said at least three shims does not mix with any other flow paths (see FIG. 2a).

Bennett et al. further discloses passing a fluid (i.e., a hydrocarbon feedstock, labeled "Reactant gas in") into the device **200** such that a fluid passes through the flow path in said at least three shims **1-8**; and performing at least one unit operation (i.e., a chemical reaction of partial oxidation) on the fluid as it passes through the flow path in said at least three shims **1-8**.

Regarding claim 11, as best understood, the flow path formed in said at least 3 shims **1-8** is defined by the borders of apertures in said shims (see FIG. 2b), wherein in each of said shims **1-8** there is a border defining a flow path, the border having a circumference (i.e., as defined by the rectangular periphery or boundary of the shims), wherein the circumference is at least 20% populated by edge features (see FIG. 2b).

Regarding claim 12, the flow path formed in said at least 3 shims **1-8** and another of said at least 3 shims **1-8** (see column 6, lines 11-21) is defined by the borders of apertures in said shims (see FIG. 2b), wherein, in at least one of said at least 3 shims **1-8**, there is a border defining a flow path, the border having a circumference (i.e., as defined by the rectangular periphery or boundary of the shims) and wherein said circumference of each shim is at least 20% populated by edge features, and the border being smooth (see FIG. 2b).

Regarding claim 13, Bennett et al. (FIG. 2a, 2b, 2c; column 5, line 51 to column 6, line 39) discloses a process of conducting a unit operation of a fluid comprising:

passing a fluid (i.e., a hydrocarbon feedstock, labeled "Reactant gas in"; FIG. 2a) into the device **200** such that the fluid passes through the flow path in said at least three shims **1-8**; and performing at least one unit operation (i.e., a partial oxidation reaction) on the fluid as it passes through the flow path in said at least three shims **1-8**.

Bennett et al. further discloses a process of making the device **200**, comprising,

stacking a plurality of shims (i.e., shims **1-8**; see FIG. 2b) such that a continuous flow path (e.g., for a Reactant Gas; see FIG. 2a) is formed through the shims; and bonding the shims **1-8** (e.g., by diffusion bonding; column 6, lines 28-35); wherein, the flow path (for Reactant Gas) extends in a direction substantially parallel to the shim thickness (see FIG. 2a, 2b); the plurality

of shims comprises at least three adjacent shims through which a flow path is formed (see column 6, lines 11-21; FIG. 2b); and a straight, unobstructed line is present through the flow path in said shims **1-8** (see column 6, lines 11-21; FIG. 2b).

Regarding claim 14, the device **200** is capable of performing a chemical reaction (i.e., a partial oxidation of a hydrocarbon feedstock).

Regarding claim 15, the flow path (i.e., for Reactant Gas) in said at least three shims does not mix with any other flow paths (see FIG. 2a).

Regarding claim 16, the fluid (i.e., the Reactant Gas) comprises at least a portion of a reaction composition (i.e., a hydrocarbon feedstock); and a second fluid (i.e., a Coolant air) passes through a second flow path in said at least three shims (see FIG. 2a).

Regarding claim 17, the fluid (i.e., the Reactant Gas) in the flow path and the second fluid (i.e., the Coolant air) in the second flow path do not mix (see FIG. 2a).

Regarding claim 21, the fluid in the second flow path is a heat exchange fluid (i.e., a coolant air; FIG. 2a).

Regarding claim 24, Bennett et al. (FIG. 2a, 2b, 2c; column 5, line 51 to column 6, line 39) discloses a process of conducting a unit operation on a fluid comprising:

passing a fluid (i.e., a hydrocarbon feedstock, labeled "Reactant gas in"; FIG. 2a) into the device **200** such that the fluid passes through the flow path in said at least three shims **1-8**; and performing at least one unit operation (i.e., a partial oxidation reaction) on the fluid as it passes through the flow path in said at least three shims **1-8**.

Bennett et al. further discloses a process of making the device **200**, comprising,

stacking a plurality of shims (i.e., shims **1-8**; see FIG. 2b) such that a continuous flow

path (e.g., for a Reactant Gas; see FIG. 2a) is formed through the shims; and bonding the shims **1-8** (e.g., by diffusion bonding; column 6, lines 28-35); wherein, the flow path (for Reactant Gas) extends in a direction substantially parallel to the shim thickness (see FIG. 2a, 2b); the plurality of shims comprises at least three adjacent shims through which a flow path is formed (see column 6, lines 11-21; FIG. 2b); and the flow path in said shims **1-8** has a minimum dimension (height or width) of at least 10 μm (i.e., from 250 μm-thick steel, column 6, lines 4-10; see also column 4, lines 16-24, for microchannel dimensions).

Regarding claim 25, the unit operation includes a chemical reaction and heat transfer, e.g., heating, and cooling (column 6, lines 35-37).

Regarding claim 26, the flow path has a maximum dimension (height or width) of at most 5000 μm (i.e., from 250 μm-thick type 316 stainless steel, column 6, lines 4-10; see also column 4, lines 16-24, for microchannel dimensions).

Regarding claim 27, Bennett et al. (FIG. 2a, 2b, 2c; column 5, line 51 to column 6, line 39) discloses a process of making a device from a plurality of shims, comprising:

stacking a plurality of shims (i.e., shims **1-8**; see FIG. 2b) such that a continuous flow path (e.g., for a Reactant Gas; see FIG. 2a) is formed through the shims; and bonding the shims **1-8** (e.g., by diffusion bonding; column 6, lines 28-35); wherein the flow path (for Reactant Gas) is substantially parallel to shim thickness (see FIG. 2a, 2b).

Bennett et al. further discloses passing a fluid (i.e., a hydrocarbon feedstock, labeled “Reactant gas in”; FIG. 2a) into the device **200** such that the fluid passes through the flow path; and performing at least one unit operation on the fluid as it passes through the flow path, wherein the unit operation involves reacting (i.e., partial oxidation) and heat transfer, e.g., heating,

cooling (column 6, lines 35-37).

Regarding claim 28, the plurality of shims **1-8** comprises at least three shims through which a flow path is formed, and a straight line can be drawn through the flow path in said at least three shims (see column 6, lines 11-21; FIG. 2b).

Regarding claim 29, Bennett et al. discloses at least two different unit operations (i.e., reaction or heat transfer, e.g., heating and cooling; column 6, lines 35-37).

Regarding claim 30, a second flow path for a heat transfer fluid (i.e., for a Coolant air) is adjacent to said flow path (i.e., for Reactant gas). (see FIG. 2a).

Regarding claims 76 and 77, the device is capable of performing at least one of the recited unit operations (see column 2, lines 1-20).

Regarding claim 78, the flow path is formed by an aperture in each of the at least three adjacent shims, wherein the aperture comprises a rectangle, square, or triangle with rounded corners (see FIG. 3a, 3b, 4a, 4c, 4e).

Instant claims 1, 2, 4-6, 8-17, 21, 24-30 and 75-78 read on the processes of Bennett et al.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any

evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 13-23, 27-31 and 80-85 are rejected under 35 U.S.C. 103(a) as being unpatentable over Autenrieth (US 6,096,286) in view of Swift et al. (US 4,516,632).

Regarding claim 13, Autenrieth (column 4, line 26 to column 5, line 15) discloses a process of conducting a unit operation of a fluid comprising:

passing a fluid (e.g., via inlets **6, 9**) into the device such that the fluid passes through the flow path (i.e., via aligned openings **14, 15, 16, 17**, forming ducts **20, 21, 22, 23** in top view; FIG. 2, 3) in at least three shims **13**; and performing at least one unit operation (i.e., a chemical reaction involving catalytic combustion, within burner unit **4** and oxidizer/burner unit **3**) on the fluid as it passes through the flow path in said at least three shims.

Autenrieth further discloses a process of making the device, comprising,

stacking a plurality of shims (i.e., plates **13**; FIG. 2) such that a continuous flow path (i.e., via aligned openings **14, 15, 16, 17**, forming ducts **20, 21, 22, 23** in top view; FIG. 2, 3) is formed through the shims; wherein the flow path is substantially parallel to shim thickness (see FIG. 1, 3), wherein the plurality of shims **13** comprises at least three shims through which a flow path (i.e., via aligned openings **14, 15, 16, 17**, forming ducts **20, 21, 22, 23** in top view; FIG. 2, 3) is formed; and wherein a straight unobstructed line is present through the flow path in said at least three shims **13** (see FIG. 1-3).

Autenrieth discloses that the shims **13** form a stack overlapping in a flush manner, with the plate edges **19** forming "gas-tight connections" through which the fluids flow. Autenrieth,

however, is silent as to the "gas-tight connections" being formed by a step of bonding the shims **13** to form the device.. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to perform the step of bonding the shims to from the device in the process of Autenrieth, on the basis of suitability for the intended use thereof, because the Examiner takes Official Notice that bonding is a well known means for achieving a gas-tight connection between adjacent shims or plates. Swift et al., for example, evidences the conventionality of bonding adjacent shims to create a gas-tight connection (see column 2, lines 34-37; column 3, lines 58-68).

Regarding claim 14, the device is capable of performing a chemical reaction (i.e., in steam reforming channels **2**) and vaporization (i.e., in evaporator channels **1**).

Regarding claim 15, the flow path (e.g., via inlet **6**, burner channels **4**, and outlet **12**) in said at least three shims **13** does not mix with any other flow paths (see FIG. 1).

Regarding claim 16, the fluid (i.e., fed to inlet **6**) comprises at least a portion of a reaction composition (i.e., a fuel, methanol for example, and/or hydrogen, and a gas containing oxygen, air for examples; column 4, lines 26-29); and a second fluid (i.e., methanol/water mixture, fed to inlet **7**; column 4, lines 34-38) passes through a second flow path (i.e., evaporator channels **1** and reformer channels **2**) in said at least three shims **13**.

Regarding claim 17, the fluid in the flow path **6/4/12** and the second fluid in the second flow path **7/1/2** do not mix (see FIG. 1).

Regarding claims 18-20, Autenrieth is silent as to the claimed separation distance between the fluids in the first flow path and the second flow path, as well as the claimed pressure difference of the fluids in the first flow path and the second flow path. In any event, it would

have been obvious for one of ordinary skill in the art at the time the invention was made to select an appropriate separation distance between the fluids in the first flow path and the second flow path in the process of Autenrieth, on the basis of suitability for the intended use and absent showing any unexpected results thereof, because changes in size merely involves routine skill in the art, and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, *In re Aller, 105 USPQ 233*. In addition, it would have been obvious for one of ordinary skill in the art at the time the invention to select an appropriate pressure difference of the fluids in the first flow and the second flow path in the process of Autenrieth, on the basis of suitability for the intended use and absent showing any unexpected results thereof, because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, *In re Aller, 105 USPQ 233*. In particular, Swift et al. teaches the use of shims having a thickness of less than 5 mm, or even less than 1 mm, in thickness, for improved heat transfer (see column 3, lines 39-45). Also, the process of bonding as taught by Swift establishes bonds between the shims or sheets having a tensile strength on the order of 60,000 psi. (column 3, lines 58-68). Thus, the device of Autenrieth, similarly bonded, would be inherently capable of achieving a pressure difference of at least 1 atm, or at least 10 atm, or at least 19 atm, between fluids in the first and second flow paths.

Regarding claim 21, the fluid in the second flow path (i.e., methanol and water in evaporator channels **1**) is a heat exchange fluid.

Regarding claim 22, FIG. 2 of Autenrieth illustrates the flow path and second flow path each comprising supports (i.e., support and distributing structures **18** on plates **13**; column 6,

lines 1-24) that extend across the flow path, with the supports being staggered (i.e., from the alternating of shims containing the flow path and the second flow path).

Regarding claim 23, the second fluid comprises a second reaction composition (i.e., methanol/water mixture, fed to inlet **7**), wherein the reaction composition (i.e., fuel and a gas containing oxygen, fed to inlet **6**, **9**) reacts exothermically (i.e., via catalytic combustion), and the second reaction composition reacts endothermically (i.e., via steam reforming). (column 4, line 25 to column 5, line 15).

Regarding claim 27, Autenrieth (column 6, lines 1-35) discloses a process of making a device from a plurality of shims, comprising:

stacking a plurality of shims (i.e., plates **13**; FIG. 2) such that a continuous flow path (i.e., via aligned openings **14**, **15**, **16**, **17**, forming ducts **20**, **21**, **22**, **23** in top view; FIG. 2, 3) is formed through the shims; wherein the flow path is substantially parallel to shim thickness (see FIG. 1, 3).

Autenrieth discloses that the shims **13** form a stack overlapping in a flush manner, with the plate edges **19** forming "gas-tight connections" through which the fluids flow. Autenrieth, however, is silent as to the "gas-tight connections" being formed by a step of bonding the shims **13** to form the device. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to perform the step of bonding the shims to from the device in the process of Autenrieth, on the basis of suitability for the intended use thereof, because the Examiner takes Official Notice that bonding is a well known means for achieving a gas-tight connection between adjacent shims or plates. Swift et al., for example, evidences the conventionality of bonding adjacent shims to create a gas-tight connection (see column 2, lines

34-37; column 3, lines 58-68).

Autenrieth further discloses passing a fluid into the device (e.g., via inlets **6, 9**) such that the fluid passes through the flow path; and performing at least one unit operation (i.e., a chemical reaction involving catalytic combustion, within burner unit **4** and oxidizer/burner unit **3**) on the fluid as it passes through the flow path (column 4, line 26 to column 5, line 15).

Regarding claim 28, the plurality of shims **13** comprises at least three shims (see FIG. 1, 3) through which a flow path is formed, and a straight line can be drawn through the flow path in said at least three shims (i.e., via aligned openings **14, 15, 16, 17**, forming ducts **20, 21, 22, 23** in top view; FIG. 2, 3).

Regarding claim 29, the device is capable of at least two different unit operations (i.e., reaction and heat transfer; column 4, line 26 to column 5, line 15).

Regarding claim 30, the device comprises a second flow path (i.e., inlet **7**, to evaporator channels **1**) adjacent to said flow path (i.e., inlet **6**, to burner **4**) and wherein a heat transfer fluid (i.e., methanol and water feed) flows through said second flow path.

Regarding claim 31, the at least two different unit operations comprise heat transfer and chemical reaction, and wherein combustion occurs in said flow path (i.e., in catalytic burner **4** and oxidizer/burner unit **3**) and steam reforming occurs in the second flow path (i.e., in reformer channels **2**). (column 4, line 25 to column 5, line 15).

Regarding claim 80, a second flow path (e.g., reformer channels 2; FIG. 1) is adjacent to said flow path (e.g., catalytic burner channels **3**) wherein, each flow path contains a different catalyst (e.g., a reforming catalyst in channels **2**, a combustion catalyst in channels **3**).

Regarding claim 81, the flow path **3** conducts an exothermic reaction (i.e., catalytic

combustion) and the second flow path **2** conducts an endothermic reaction (i.e., a methanol reforming reaction)

Regarding claims 82-84, Autenrieth discloses a catalyst (e.g., a reforming catalyst in channels **2**, a combustion catalyst in channels **3**) provided in the flow path. Autenrieth, however, is silent as to physical form of the catalyst. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to select a known, appropriate, form for the catalyst (such as the claimed metal film or metal on an oxide support) in the modified apparatus of Autenrieth, on the basis of suitability for the intended use thereof, because the Examiner takes Official Notice that such catalyst forms are well known in the art of catalysis.

Regarding claim 85, the flow path is formed from at least five shims **13** (see FIG. 1-3), wherein a straight, unobstructed line is present through said flow path (e.g., via the manifolds of evaporator channels **1**, or the manifolds of reformed channels **2**, or the manifolds of oxidizer/burner channels **3**, or the manifolds of catalytic burner channels **4**; said manifolds being defined by the alignment of apertures **14, 15, 16, 17** in shims **13**).

Response to Arguments

7. Applicant's arguments filed January 13, 2006 have been fully considered but they are not persuasive.

<u>Schoenman et al.</u>

On page 18 of the response, Applicants argue,

> "... In Schoenman, the unit operation (chemical reaction) occurs outside the device or (heat transfer) on the surface of the plate. There is no unit operation occurring in the flow path in plates **16, 18, 20, 22, 24** of Schoenman."

The Examiner respectfully disagrees. Schoenman discloses in several locations that a "unit

operation" is performed on a fluid within the device, and hence, a fluid in the flow path. For example,

> "Device **10** operates in a threefold manner.... it defines a coolant system wherein heat input from the region adjacent to end plate **12** is *conducted to one or several of the fluids passing through the device*; and it serves as an atomization and mixing system tailored to accommodate selected fluids." (column 3, lines 24-30; emphasis added).

The unit operation of heat transfer is performed on the fluid within the flow path. Also,

> "... the mixing of two different fluids *can occur interiorly or exteriorly of the device* during or after atomization." (column 2, lines 29-35), wherein the fluids may comprise reactive fluids (see column 2, lines 4-20).

The device is capable of being used for conducting a reaction interiorly of the device (e.g., by mixing two reactive fluids) and within the flow path. It is further noted that several of the independent claims merely recite a process of using the device to broadly conduct a "unit operation". The Examiner asserts that any operation on the fluid would meet the claims, including the simple act of transporting the fluid through the device, without any physical and/or chemical change to the fluid (e.g., the unit operation of fluid transport or fluid distribution).

Applicants further argue,

"With regard to claim 7, Schoenman does not disclose a static mixer in the flow path."

The Examiner respectfully disagrees and asserts that the opposing passages **134**, for direct impingement of fluids entering paths **126**, **128** (FIG. 3), defines a static mixer because the mixing of the fluids is accomplished within the device without the use of moving parts. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., a particular static mixer

structure) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Applicants further argue,

"With regard to claims 10, 24, and 27, it is improper to ignore claim limitation."

The Examiner respectfully disagrees and asserts that the claim limitations were not ignored. See the specific remarks for claims 10, 24 and 27 in the previous office action, set forth by the phrase, "In any event…".

Applicants further argue,

> "With regard to claims 11 and 12 … edge features are discussed on page 13 of applicants' specification and illustrated in Fig. 9. In contrast, Schoenman's aperture borders are smooth - there are no edge features."

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., a particular edge feature construction) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

<u>Bennett et al.</u>

On page 19, first paragraph, of the response, Applicants argue,

> "In Bennett, the unit operations occur perpendicular to the shim thickness. This is opposite of applicants' claimed invention."

The Examiner respectfully disagrees and maintains that the device/process of Bennett meets the

claims. Claim 1 recites,

> … stacking a plurality of shims such that a continuous flow path is formed through the shims;
> wherein the flow path extends in a direction substantially parallel to shim thickness…

When we compare the language of the claim to FIG. 1b of Bennett, for instance, Bennett shows a flow path for Fluid A, which is continuous through the shims **120** from an inlet on a first shim to an outlet on the last shim. The general direction of the flow of Fluid A through the shims is "substantially" parallel to the shim thickness. The language of the claim, however, does not restrict the flow path to a direction that is strictly parallel to the shim thickness. Therefore, although unit operations may occur in the portions of the flow path that are perpendicular to the shim thickness, the device/process still meets the claim because these portions are still considered part of the continuous flow path.

<u>Autenrieth in view of Swift et al.</u>

On page 20 of the response, Applicants argue,

"Autenrieth teaches a conventional shim design in which unit operations occur perpendicular to shim thickness. This is opposite of applicants' claimed invention."

Again, the Examiner respectfully disagrees and maintains that the modified device/process of Autenrieth meets the claims. Claim 1 recites,

> … stacking a plurality of shims such that a continuous flow path is formed through the shims;
> wherein the flow path extends in a direction substantially parallel to shim thickness…

When we compare the language of the claim to FIG. 1 of Autenrieth, for instance, Autenrieth

shows a flow path for a first fluid entering through an evaporator inlet **7** and flowing through a continuous flow path comprising evaporator channels **1** and reformer channels **2** to an outlet of the device, not shown. The general direction of the flow of the fluid through the shims (i.e., the plates **13**; FIG. 2) is "substantially" parallel to the shim thickness. The language of the claim, however, does not restrict the flow path to a direction that is strictly parallel to the shim thickness. Therefore, although unit operations may occur in the portions of the flow path that are perpendicular to the shim thickness, the device/process still meets the claim because these portions are still considered part of the continuous flow path.

As further seen in FIG. 1, a straight line can be drawn through the flow path in at least three shims (e.g., via manifold of evaporator channels **1**, or manifold of reformed channels **2**, or manifold of oxidizer/burner channels **3**, or manifold of catalytic burner channels **4**; said manifolds being defined by the alignment of apertures **14, 15, 16, 17** in shims **13**).

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

* * *

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer A. Leung
April 24, 2006 JAL

Alexa Neckel
ALEXA DOROSHENK NECKEL
PRIMARY EXAMINER